

ART. XIX.-*Notice of a recent Land-slide on Mount Passaconaway*; by GEO. H. PERKINS, Ph.D., Prof. Zoology and Geology, University of Vermont.

THE name Passaconaway is given to a somewhat extended mountain in Grafton county, New Hampshire, twenty miles northeast of Plymouth, and about the same distance southwest of Mount Washington. It consists mainly of three conical peaks of nearly equal height, which form a group at the southern end, and of a high ridge running several miles northeast. A much smaller ridge stretches in a southerly direction. During the great rain of October 4th, there was an unusually large land-slide upon the southwestern slope of the most southern of the three highest summits. The light-colored streak down the mountain side, which marked the course of the slide, could be distinctly seen for more than fifty miles. It was at this distance that I first saw it, two weeks after its occurrence, and with my friend Rev. M. T. Runnels of Sanbornton, set out to examine it. At Campton we were joined by Mr. Chas. Cutter, to whose knowledge of the region and general kindness, much of our success was due. From Campton a ride of ten miles in a northeasterly direction up Mad River valley brought us to Waterville; thence we proceeded on foot. After walking two or three miles we reached a level clearing of fifty acres through which Mad river runs, here only a few yards across. This space was covered with great heaps of logs, some of them very large, brought down from the debris of the slide during the freshet that attended or followed it. That they came from the slide was very evident, for nearly all were broken as if suddenly snapped in two, many had one or both ends crushed to splinters so fine that they seemed like great brushes, and all were entirely stripped of foliage and of most of the smaller branches.

These logs were mainly spruce, and some were fifty to sixty feet long, and one to two feet in diameter. They were piled up in great confusion to the height of fifteen or twenty feet. Subsequent investigation showed that this was at least three miles below the terminus of the slide. Nowhere else was there such a mass of timber as here, nor any where else was the ground so favorable for such an accumulation; for elsewhere the banks of the stream were high and rocky, and not more than eight to twelve rods apart.

The whole mountain is covered to the very top with a forest of spruce, and to reach the slide most easily we followed the bed of the stream along its side. At short intervals were piles of logs more or less broken, by which the stream had evidently been in several places completely dammed.

Trees on the banks twenty feet or more above the water were scarred, rubbed, and even uprooted, by those borne on the current of the swollen stream. A toilsome walk brought us to the foot of the slide which lay directly in the bed of the stream. This side of the mountain is quite steep, and in outline regularly triangular. Its height is about four thousand two hundred feet.

The slide commences forty rods from its summit, and a little to one side of the highest point. At the outset it is very narrow, being not more than a rod wide; a narrow tongue runs above this, however, for a short distance. For fifty or sixty rods the increase in width is very gradual. The inclination is very steep, appearing almost perpendicular and probably not less than fifty to sixty degrees. For the next hundred rods the width increases more rapidly. A hundred and thirty rods from the top the widest part is reached. Here the sides bend gradually outward and the width is twenty-five to thirty rods. From this point the sides begin slowly to approach each other, and thirty-six rods below, a hundred and fifty-six from the top, the width is nearly seventeen rods. The course from the top to this point is in a direct line, but here a curve toward the northwest begins and ends eighty rods below, nearly at a right angle with the main axis. The whole length is nearly two hundred and forty rods, and the outline is fusiform, with the lower end curved to one side. Directly across the line of the main axis a few rods from the foot of the mountain runs a high ridge. Instead of striking this, as would have been expected, the slide begins to turn nearly a hundred rods above, and when within twenty rods is almost parallel with it. There seems to be no reason why sand, rocks and débris of all sorts should not have been thrown against this ridge; indeed there is every reason why they should have been. Yet the space between it and the slide is singularly free from such material. There is undoubted evidence that one or more watercourses ran down the mountain before the slide, and probably did much to cause it. These streams, which form part of the source of Mad river, must have been very inconsiderable, and yet the mass of rock and sand seems to have been guided by them in its downward course. It appears incredible that so great a mass moving with power and velocity enough to snap off hundreds of great trees, crushing many of them to splinters, and piling up such heaps of débris, could be directed by such small watercourses, but the facts indicate it.

There has for a long time, been the track of a former slide down a part of the surface covered by the more recent one, but it was very small. Contrary to our expectations the side of the mountain over which the slide passed, was not bare rock

stripped of surface material. Only in two places, both small in extent, was the rock foundation of the mountain exposed. One of these was at the top where the slide seemed to have started from a ledge, the other was a little less than half-way down, and reached entirely across the track of the slide. With these exceptions the whole surface was covered with a loose, coarse sand or gravel, consisting entirely of comminuted rock, increasing in depth from top to bottom and very loosely compacted. The thickness of this loose material was shown along the sides of several small streams that were running down the slide, which, at the time of our visit, the 20th of October, had cut entirely through it, and ran over the solid rock beneath. Near the top the ground was moist but there were no streams; these began twenty or thirty rods farther down. At the top of the slide, the surface sand was only a few inches deep; below the second exposure of rock it was between one and two feet; at the widest part, a hundred and thirty rods from the top, it was from six to eight feet; a hundred and fifty rods, it was nine to ten feet, and at the bottom fifteen to twenty-five, and in some places, even thirty feet deep. At this point the slide seemed to have suddenly stopped, for there was no gradual diminution in thickness below it.

How much of this coarse gravelly sand originated with the slide, being ground by it from larger rocks; and how much existed before as surface soil disintegrated from the solid rock, I could not estimate. The sand was pure syenite and contained no trace that I could find, of any vegetable mold. From an examination of the banks of Mad river below, and of the soil by the side of the slide, I am convinced that the greater part was produced by the disintegration and falling to pieces of the mountain's rock, and so existed before the slide, and was carried along and heaped up by it. The mountain is, so far as I could learn, wholly composed of light gray, rather coarse syenite, which appeared to disintegrate very readily, as I saw large masses that could easily be pulverized. A mile below the slide there were extensive layers of black hornblende rock, and in one place the syenite was crossed by trap dikes, from an inch to a foot in thickness. Some of these dikes forked several times, others crossed each other in the form of a letter X, and some varied greatly in thickness along their course. A few broken crystals of rose-purple quartz, an inch or more in diameter, were found among the debris. But the only rock in place along the course of the slide was the syenite.

Scattered all over the surface of this loose, sandy material, were masses of syenite, of various sizes though none were very large. These were angular, and appeared to have been recently broken. They were undoubtedly fragments of large

masses broken by the slide. Besides these, there were a few well worn boulders of syenite, quartz, and hornblende rock, some of which were near the top.

All the trees that had stood on the ground now occupied by the débris of the slide, were carried away or buried up, only a very few bare logs remaining in sight.

Along the sides of the slide the forest was full of uprooted, bruised, and broken trees.

The upper part of the slide was much more rugged and covered with a greater mass of broken rocks than the lower. Over the widest portion there were few rocks on the surface, which was smooth and level as if rolled. Below this it was rougher but not as much so as above.

The appearance of the surface was the same in all parts. Its color was a light yellowish brown, and at a little distance it closely resembled a field lately ploughed and harrowed.

It is the contrast of light color with the dark green of the spruce forest around it that causes the slide to be so distinctly visible at long distances. As is stated above, the upper portion of the slide is very steep, but after the first fifty rods the angle of inclination is less, and just above the widest part it is not more than twenty-five degrees. Below it is not more than fifteen degrees.